Advanced Design for Sustainability - reflection upon a new teaching approach

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'Advanced Design for Sustainability - reflection upon a new teaching approach'

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Abstract

This paper reports upon and discusses a new teaching approach for the course 'Advanced Design for Sustainability' within the educational master program of product development, faculty of design sciences, at the University of Antwerp. The course of Advanced Design for Sustainability persuades a basic training of ecodesign, in which the general principles are educated, and tools and strategies related to ecodesign are discussed. The aim of this advanced elective course is to extend the students' knowledge related to ecodesign and to apply it in practice. In cooperation with a company, a concrete case will be elaborated. Afterwards, the students are asked to generate sustainable solutions to the offered problem.

To achieve the highest results, a new teaching approach was developed, in which an industrial company is working together with a group of master students with the aim to solve one sustainable issue, using some defined idea generation techniques. In order to offer a variety of contexts and problems to the group of students, the course is split into different half day lessons, each focusing on a different company. Each lesson is based upon a rigid and verified structure, consisting of four parts: (1) problem definition, (2) idea generation, (3) idea evaluation and selection, and (4) implementation.

In addition to the explanation of the new teaching approach, we report in this paper also upon the strengths and opportunities of the teaching method, and discuss the threats for all parties (teachers, students and companies). In short, the added value for participating companies: (a) they achieve a minimum of twenty wild goose concepts that can be used for further internal discussion, (b) they achieve a better understanding of the capabilities of master students product development, which might become their future employees. Students learn, in these short half day exercises, both dealing with sustainable issues in companies and learn practicing ideation tools. An extra added value for master students is that they achieve in-house information of some companies, which can influence their career development interests. For teachers: organizing this type of courses is no extra effort for teachers, as instead of writing and optimizing a theoretical schoolbook, effort is put in contacting companies, discussing the most appropriate problems and choosing the right ideation tools.

1 Introduction

Ecodesign or Design for Sustainability is a discipline within product development in which the focus is put on the eco-impact of products and in which the full product life cycle should be considered (starting at choice of materials, production and assemblage, distribution and packaging, product use phase, and the end of life). Having the aim to go from a linear to a circular economy and reuse or recycle as much material as possible (Van Doorsselaer & Du Bois 2015). It is crucial to inform future product designers about the ecological problems and educate them how they can minimize the impact of products if we consider that 80 % of the environmental impact of product is determined in the design process (Design

Council 2002). Consequently, Ecodesign is one of the standard courses that is embedded in the bachelor curriculum of Product Development at the faculty of Design Sciences, University of Antwerp. In this course the environmental problems are educated and general principles for ecodesign are learned. Attention is put on the different eco-analysis tools, design guidelines towards more sustainable products, and the most used terms and strategies related to ecodesign. This theoretical course is supported by several practical design courses in which students have to apply their knowledge to design products with a low environmental impact. However, for those students who are interested in learning more, an Advanced Design for Sustainability course is organised as an elective in the master curriculum of Product Development. This 3ECTS-course aims to extend the students' knowledge related to ecodesign and to build experience with applying it in practice.

This paper describes and reflects upon the new teaching approach that is currently used since 2010 in this 'Advanced Design for Sustainability' course. As the course transcends the basic training of ecodesign, the aim is to apply the general principles, tools and strategies in a real industrial context and extend the students' knowledge related to ecodesign by learning new tools. Because of the complexity of dealing with sustainability problems, the students should learn facing the very different challenges and develop the ability to monitor the whole. Sustainability is not just about environmental benefit but also about useful products and added value. As discussed by Nyström Claesson and Svanström (Nyström Claesson & Svanström 2015), handling complexity becomes more and more urgent in order to manage climate change, increased levels of chemicals in society, conversion of the energy system, food and water supply and many other challenges. To be able to act in a relevant way, students need to develop skills such as systems thinking to be able to assess complex systems. Systems thinking for sustainable development has been described as "the ability to collectively analyse complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global), thereby considering cascading effects, inertia, feedback loops and other systemic features related to sustainability issues and sustainability problem-solving frameworks" (Wiek et al. 2011).

The elective has been highly useful as a platform to pilot new ways of teaching engineering for sustainable development, as we wanted to challenge our students to develop a critical understanding of sustainability. Currently, a new teaching approach was developed, in which an industrial company is working together with a group of master students with the aim to solve one of their ecodesign issues, using some defined idea generation techniques. In cooperation with a specific company, a concrete case will be elaborated. This allows our students to consider the complex environment in which the problem is situated (on level of technology, economy, social and environmental aspects). Afterwards, the students are supported to generate sustainable solutions to the offered problem. Our objective in this paper is to illustrate how such a new approach works in practice and how it has helped students to develop a more critical, systemic perspective on sustainability. Lastly, in the paper, we also reflect on the advantages and disadvantages for all involved stakeholders.

2 Detailing the teaching approach

2.1 Structure of the course

The course is structured in six separate lessons. From which three different lessons are focussing on testing and experiencing new tools such as biomimicry (Benyus 1997; the Biomimicry Institute n.d.), SIS toolkit (OVAM 2012), Design with intent (Lockton et al. 2010), etc. The other lessons are considering a concrete case elaboration. In order to offer a variety of contexts and problems to the group of students, each focusing on a different company. Each lesson is based upon a rigid and verified

structure, consisting of four parts: (1) problem definition, (2) idea generation, (3) idea evaluation and selection, and (4) implementation. Each lesson takes about four hours and case elaboration always needs some homework in order to finish the idea implementation part (explained further in the Section below). The course is evaluated using permanent evaluation, taking the students' participation and the ideations' results into account).

2.2 Detailing one specific lesson

Each sustainable-ideation lesson is structured in the same manner using the Idea2Market-toolbox (Dewit & Du Bois 2009). This toolbox structures the ideation using four phases: (i) a problem definition phase, (ii) an idea generation phase, (iii) an idea selection and evaluation phase, and (iv) an idea implementation phase. The toolbox aims to facilitate the ideation process by suggesting to use specific tools in each phase and by indicating the assets and competences that are of importance. Within this framework specific advanced ecodesign tools were selected to increase the students' knowledge.

Important to notice is that as we (teachers) always prepare the lesson together with the company during a preshoot-session. Because every ideation has a different focus, complexity, level of detail, etc., the toolbox suggests to prepare each ideation in a preshoot-ing phase. The aim of the preshoot is not only to get to know the company better and to understand the problem, but also to decide which tools are the most relevant for the problem and for the students. For each phase, a maximum of two or three different tools are selected. The structure of each ideation is visualized in a template, as shown in Figure 1.

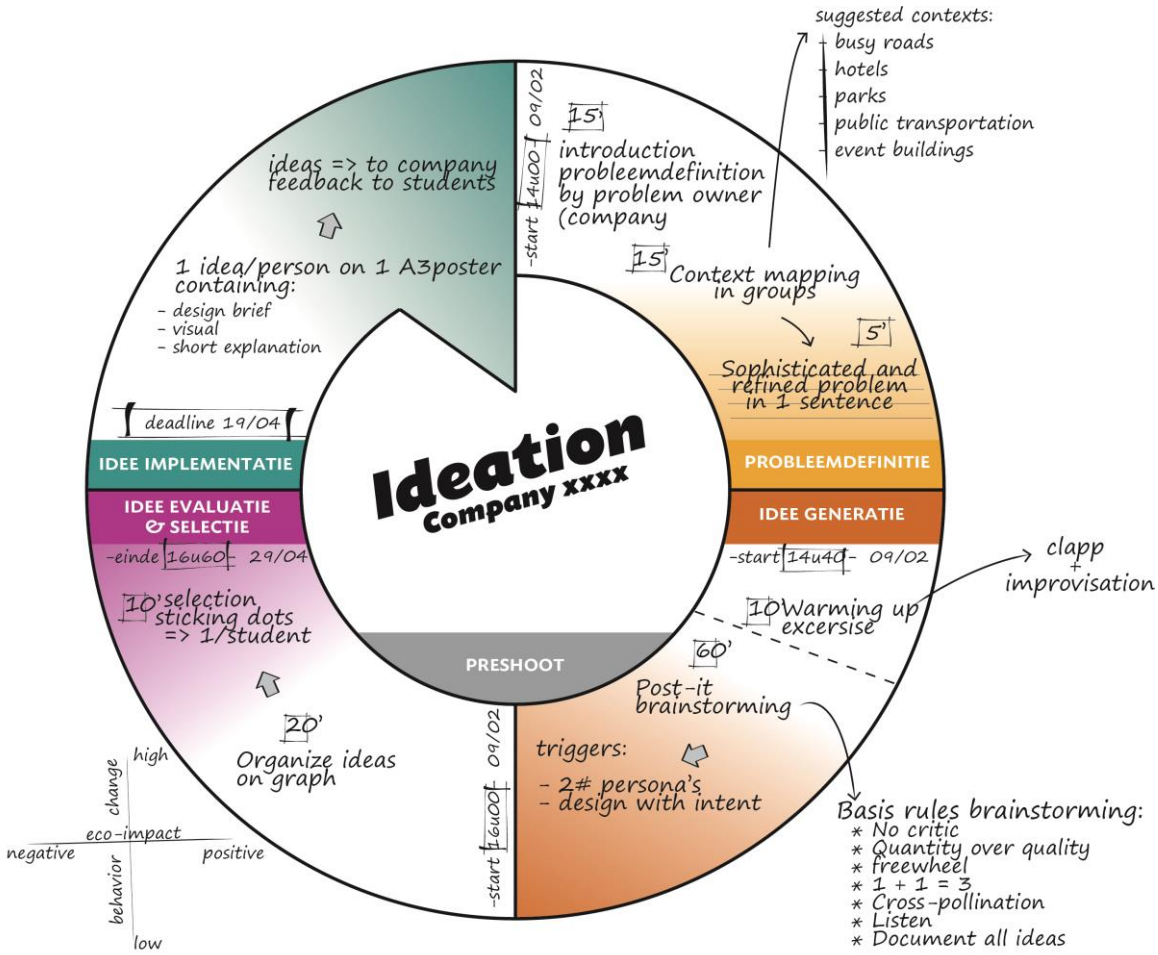

Figure 1. example ideation-case filled in on the standard template during the preshoot phase

In short, the 'Problem Definition'-phase, aims to support the students to clarify and boundary the problem. Often collection of information and creation of a reference model are two crucial steps to be able to define a common problem statement. At the end of the phase, the students should be able to formulate together a single sentence in which the problem or opportunity for their case is detailed on a sufficient level. Ecodesign tools that are important to consider in this phase are all eco-analysis tools, both quantitative and qualitative, as a source to explore the problem. Next to this, context mapping and system mapping tools are also used in order to be able to capture the complex problem, to keep the overview and to visualize the relationships among the actors.

In order to empty the students' brain and activate a non-school mentality, we organize a special warming up exercise in between problem definition and idea generation. The exercises are inspired on improvisation theatre and force students to act unnatural and spontaneous. Depending on the type of students and the problem definition, we force them to play the clap-game, play name games, or make free associations with gestures (Johnstone 2012).

The next step, the 'Idea generation'-phase is the phase that is standard characterized as brainstorming. However, brainstorming is only one of the idea generation techniques that can be applied to generate as much ideas as possible, without judgment or evaluation. To upgrade the level and number of ideas, extra tools can be used to get more inspiration. Related to ecodesign, we often use tools such as biomimicry (ask nature (the Biomimicry Institute n.d.)), eco-triggers, eco-heroes (narrowing 'what would x do?' (Jarvis 2009)) in order to trigger ourselves to think outside the box or to approach the problem from a different perspective. Qualitative eco-analysis tools (such as checklists (Wimmer 1999), Eco-Star (Van Doorsselaer 2009), LiDS wheel (Brezet & van Hemel 1997)) are also used in this phase as they also offer triggers for optimization.

The mass of all ideas should be taken into the next 'Idea Evaluation and Selection'-phase, in which they will be evaluated and the best ideas will be selected. Based upon the criteria that were formulated in the first phase, an underpinned evaluation and selection can be carried out. To support this phase, different selection tools can be used, nevertheless it is important to use multiple aspects of the environmental impact as selection criteria.

Lastly, the Implementation-phase has the objective to insure further succession and monitoring of the best ideas. Communication of generated ideas is crucial and the creation of a buy in of those people in the company that have the power to succeed is necessary. This can be achieved by visualizing the ideas, using different platforms. Next to communication, the implementation phase also supports people to thoughtful motivate the idea. Ecodesign tools that show the potentials for improvement (such as the Eco-star) can be used as argumentation.

3 Reflection and discussion upon the educational approach

In the past six years, 167 students have followed the elective. From the 15 opportunities, the elective Advanced Design for Sustainability is among the most popular electives. In this course, students of both first and second master students participate together. Students have to choose four electives over these two year period.

Reflecting upon the general approach using the Idea2Market toolbox with specific ecodesign tools, we experience two specific added values: (i) The communication among the different stakeholders (teachers and the industrial partners, but also with students) is straightforward and effective because a standard template is used to structure the preshoot-discussion, as shown in Figure 1. (ii) The selection and application of the different tools increase, for the companies, the guarantee for effectiveness.

Simultaneously, students get practical experience with new specific tools. In general, we can conclude that the Idea2market toolbox is an efficient enabler for advanced design for sustainability. The additional approach of adding warming up tools is evaluated positively by all stakeholders. Although both students and company initially behave aloof, after the seriousness of the teachers all students and most company people overcome their fear to act different. This change of behavior has a positive effect on the students' behavior during the idea generation phase.

Reflecting upon the type of companies that are willing to participate in the course, we found that companies only participate if sustainability is an important aspect in their mission. The persons, representing the company, are either involved in industrial product design and/or sustainability. The largest issue for finding interesting companies is the fact that they don't know about the opportunity.

To reflect upon the approach from the perspective of each stakeholder, we reasoned about the strengths and opportunities of the teaching method, and discusses the input versus return and its threats for all parties (teachers, students and companies).

Companies' input include the context information and the problem statement they offer as case towards the students. The added value for participating companies: (i) only a limited time investment is asked from the company (two hours preparation and a half day lesson), but (ii) they achieve a minimum of twenty wild goose concepts that can be used for further internal discussion, (iii) they achieve a better understanding of the capabilities of master students in product development, which might become their future employees; and (iv) they learn new tools. Possible threats: (i) the image building of the company may be lowered due to the fact that they come outside with a specific environmental problem. However, this threat can easily be tackled towards the students, it is often a difficult internal decision for companies. (ii) as the collaboration is within the context of education, there is no guarantee for useful results.

Students' investment is funded with the credits they receive for the elective and with the knowledge they receive. In these short half day exercises, students learn both dealing with sustainable issues in companies and learn practicing ideation tools. The reality of the cases increases the value for the students enormously and triggers their interest and enthusiasm. An extra added value for master students is that they achieve in-house information of some companies, which can influence their career development interests. The largest threat for students is that due to the varying level of company-problems, the exact content of the lessons vary. Each year other tools and other contexts (and companies) are investigated, which might give the students an unfair feeling comparing the products over the different years.

For teachers: organizing this type of courses is no extra effort for teachers, as instead of writing and optimizing a theoretical schoolbook, effort is put in contacting companies, discussing the most appropriate problems and choosing the right ideation tools. Using new ecodesign tools obviously requires a good understanding of teachers how these new tools can be applied in different situations and contexts. The largest threat for the teaching staff is to ensure the availability of relevant cases. Although this seems to be interesting for companies, it is not evident to find companies that are willing to cooperate. Currently, the collaborations result from personal contact and accidental meetings. More investigation is needed to consider how this can be officialised.

In addition, we experienced an added value for other stakeholders who are sometimes involved in the different sessions. Often the new tools were developed as a result of research activities, and need further exploitation, application and verification in educational and company contexts. The context of the course is consequently used a concrete testing case.

Further discussion is needed to determine how to avoid potential concurrence with those companies who offer idea-generation-services as business strategy. Currently, the companies do not pay for the often

very valuable outcome. Obviously, in contrast to those companies, these sessions are situated in an educational context and should follow the educational planning, which makes it less flexible. For the moment, these companies do not consider the university as a competitor because the amount of cases is relatively low. Further exploitation of this approach in other courses requires substantial thinking and development of a business model.

4 Conclusions

In this paper, we presented a new teaching approach, used in the advanced design for sustainability course, in which master students are working on different cases of real-life sustainability issues introduced by an industrial company. After founded reflection, we can conclude that the approach can considered to be innovative and very effective and enriching, due to the following aspects: (i) concrete realistic cases increase the interest of students; (ii) new tools are experienced (added value for students and companies); (iii) companies achieve wild goose ideas with a minimum time investment. (iv) The courses are structured efficiently, using a similar framework and within a limited time schedule. This allows teachers to efficiently organize the cases within their lessons.

Involvement of industry practices in an educational context is a bottleneck in many educational programs and industry (in general) is often complaining about the difference between the theoretical approach handled in university and the practical economic situation in their businesses. Nevertheless, it is experienced as a difficulty to find new companies to participate in this course.

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